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Sandøe, Peter; Forkman, Björn; Christiansen, Stine Billeschou

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Scientific uncertainty – how should it be handled in relation to scientific advice regarding animal welfare issues?[1]

P Sandøe[1], B Forkman[2] and S B Christiansen[1]

1 Centre for Bioethics and Risk Assessment, Royal Veterinary and Agricultural University, Copenhagen, Denmark
2 Department of Animal Science and Animal Health, Royal Veterinary and Agricultural University, Copenhagen, Denmark

Abstract

The provision of advice on animal welfare is an important part of the work of scientists in applied ethology, neurophysiology, veterinary epidemiology and other disciplines. Those who request guidance often expect advice that will help them to make progress in difficult discussions. Scientists want to live up to these expectations, but it is also important for them to clarify any scientific limitations. They are normally aware of limits to their advice, but these limits are sometimes not explicitly stated.

Using the phrase broadly, we call this kind of limitation 'scientific uncertainty'. We distinguish between the following four types of uncertainty: 1. Ontological uncertainty, relating to the existence of animal feelings and other states relevant for animal welfare. 2. Conceptual uncertainty, stemming from the fact that some of the concepts used in animal welfare science are value-laden if used outside a narrow scientific context. 3. Lack of scientific evidence, stemming from lack of scientific data on the problem in question. 4. Uncertainty about priorities, relating to the practical conclusions to be drawn in a situation with an open-ended set of ethical and other practical considerations.

Scientific uncertainty is unavoidable. It is therefore essential, when giving scientific advice, to state the assumptions on which the advice is based. This makes scientific advice more objective, but also of a more limited value to those who do not share the underlying assumptions.

Introduction

Science has an important role to play in debates about animal welfare. A variety of stakeholders take part in these debates: animal welfare organisations, concerned citizens, politicians, farmers' organisations, retailers, public authorities and others. These stakeholders disagree about many things, but in the main they seem to agree that scientific investigations can play a useful role in

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documenting welfare problems and identifying ways of improving the welfare of farm, laboratory and other animals used by man. Indeed one of the main reasons for the huge increase in funding for animal welfare research over the last three decades, especially in Northern Europe, seems to be the belief that science has an important role to play in helping to find solutions to problems of animal welfare.

The results of scientific investigations may enter discussions about animal welfare in ways that leave scientists themselves with little control. Thus stakeholders may attend conferences, read the relevant journals and in others ways get hold of results in animal welfare science, and then make use of these results as they think fit. Again, one way or another results may be picked up by the media and reported in an inaccurate or one-sided way. However, to some extent scientists are in control. They write conclusions in their papers in which, in a more or less clear and balanced way, they try to explain the animal welfare implications of their results. Sometimes they produce reviews or special reports in which they try to summarise existing knowledge of animal welfare within a certain area; and sometimes they serve as experts on animal welfare on various committees, commissions or councils. And of course, some scientists take jobs in animal welfare organisations, farmers' organisations and the like, and advise the relevant stakeholder directly.

Scientists, then, are involved in giving advice on animal welfare in a number of ways. Whatever his or her advisory role, it is, of course, important for the scientist to report what is known accurately and fairly. However, it is equally important — and indeed part of accurate, fair representation — to indicate the *limitations* of the scientific contribution. If these limitations are not made clear, conclusions may be drawn in the name of science that go beyond the data and are in this sense unscientific. In the short run there may be an advantage to the scientists involved: it may look as though science is making a significant contribution to the documentation or solution of an animal welfare problem. However, in the longer term this may backfire badly, because science may come to be viewed as part and parcel of a biased and political agenda.

The aim of this paper is to reflect on the limits faced by scientists when giving advice on animal welfare We call such limits *scientific uncertainty*. Four sub-varieties of scientific uncertainty can be distinguished: 1) Ontological uncertainty: Deep issues concerning the existence of animal feelings, the nature of animals etc. 2) Conceptual uncertainty: Is the notion of animal welfare on which the advice is based explicitly defined, and does it correspond to the definition of those who are going to make use of the advice? 3) Lack of scientific evidence: Have the right kind of empirical studies been conducted, enabling conclusions to be drawn on the issue? 4) Uncertainty about priorities: In making recommendations, scientists will implicitly weigh different values or concerns against one another, but are the reasons behind these weightings generally acceptable?

In the following sections, these forms of uncertainty will be discussed in turn. In each section, examples will be given illustrating how failure to address the relevant kind of uncertainty may play a role when giving advice on animal welfare.

Ontological uncertainty

Animal welfare is a concern for us partly — if not only — because we think that from the point of view of the animals it makes a difference how they are being treated. Non-human animals may experience pain; they may feel various forms of discomfort; they may experience pleasure, and even feel happy. Or so we think, at least.

If one approaches the scientific literature to find out about the mental life of members of a certain animal species it will soon become clear that scientific observations by themselves can make only a very limited contribution to this subject. There is, it seems, no direct access to the subjective mental experience of the animal. If anything is to be said about the mental states, scientific data must be interpreted. Such interpretations can be based on argument-by-analogy, as explained by Sherwin (2001): "we observe whether an animal responds to putatively negative stimulus in a similar way to ourselves, and if it does, we assume the animal's experience must be analogous." The difficulty of gaining access to an animal's subjective experience is well illustrated by the ongoing discussion of the ability of fish to feel pain.

In recent years, the use of fish in research and as a farmed species has increased. As with other animal species, there is a desire to ensure that the welfare of fish is not compromised in a research or farming situation. However, much less is known about fish than other farmed species, and as a starting point the concern for fish welfare faces a crucial point in the debate: are fish able to suffer and feel pain? This question obviously has profound implications. If fish are unable to suffer and feel pain, one can argue that taking steps to safeguard their welfare makes no sense, at least if good welfare is taken to consist in e.g. the absence of pain and other aversive mental states. And conversely, if fish are able to feel pain this would have huge implications not only for fish on farms and in research, but for commercial and sports fishing as well. When looking to science for an answer different approaches can be found.

Rose (2002) looks at the issue from the perspective of neuroscience, taking pain perception in humans as a reference point for the assessment of pain perception in fish. He emphasises the need to distinguish between nociception and pain: "The points critical to understanding differences between fishes and humans with respect to pain are that: (1) pain is both a sensory and emotional experience (that requires conscious awareness) and (2) nociception does not result in pain unless the neural activity associated with it reaches consciousness". He argues further: "Because the higher brain level responsible for awareness of the sensory and emotional dimensions of pain does not exist in fish brains, all of their neurobehavioural activity to noxious stimuli is nociception and not pain". And he concludes: "The fundamental neural requirements for pain and suffering are now known. Fishes lack the most important of these required neural structures, and they have no alternative neural systems for producing the pain experience. Therefore the reactions of fishes to noxious stimuli are nociceptive and without conscious awareness of pain" (Rose, 2002).

Rose appears to assume that if fish experience pain, that pain must involve an experience, and an underlying neurological mechanism, that are very similar to that in humans. However, others may see the analogy to humans differently. Thus, in discussing the use of analogy in relation to

invertebrates, Sherwin (2001) points out that "the experience may be 'analogous' — not necessarily 'identical' — in the same way that vision, olfaction, respiration, etc. may be analogous but not identical".

Following the same line of thought, Sneddon et al. (2003) also take human pain as a starting point, but acknowledge that "what an animal 'feels' is possibly nothing like the experience of humans with a more complex brain structure; however, the animal's experience may be unpleasant or cause suffering and their discomfort is no less important in terms of biology or ethics". They base their conclusions on both physiological and behavioural observations, and suggest that the following criteria must be met for animal pain: "First, the demonstration of the sensory capability of detecting potentially painful stimuli, and, second, the performance of adverse behavioural responses to a potentially harmful event that are not simple reflexes".

While agreeing with Rose about the capacity for nociception in fish, Sneddon et al. adopt a wider view of pain perception: "The results of the present study demonstrate nociception and suggest that noxious stimulation in the rainbow trout has adverse behavioural and physiological effects. This fulfils the criteria for animal pain".

It is important to note here that scientific uncertainty about fish pain affects not only the question whether fish can feel pain, but also the issue of how further enquiry should proceed. For Rose, the conclusion that fish cannot perceive pain in effect closes the case. In contrast with this, Sneddon et al. find their results to support the belief that fish can feel pain and suggest further investigation: "Future work should examine the cognitive aspects of noxious stimulation to assess how important enduring a noxious potentially painful event is to the mental well-being of this species". Thus there is not only a disagreement about whether or not fish can feel pain, but also about whether the area merits further research.

Working in an advisory role, it may at this point be difficult to take a stand on the issue of pain in fish. Some scientists say fish do not feel pain, some say they might do so, and it is not clear whether the difference here really concerns the ability of fish to feel pain or rather what kind of pain to accept as a reference point. Some have, however, taken a stand. After reviewing the literature, FSBI (2002) came to the following conclusion, on which their recommendations were made: "In mammals opiates act at neural levels below the neocortex (Rose, 2002), but this does not preclude their having a pain suppressing effect and one has to ask why they are needed in fish if these animals do not experience pain...[..]..findings suggest that fish have the sense organs and the sensory processing systems required to perceive harmful stimuli and, probably, the central nervous systems necessary to experience at least some of the adverse states that we associate with pain in animals. Hence our working position that fish have the capacity to perceive painful stimuli and that these are, at least, strongly aversive".

Here, what is known, what is not known, and what assumptions underlie the recommendations to follow, are stated explicitly. Similarly, Sherwin (2001) presents different interpretations of the argument-by-analogy and leaves the reader with the option of accepting, modifying or rejecting the use of analogies e.g. in the assessment of pain in animals. By making such uncertainties transparent,

the author enables the reader to draw his or her own conclusions about the assumptions and recommendations presented.

Conceptual uncertainty

Notions such as 'animal welfare', 'needs', 'stress' and 'suffering' are often used when giving scientific advice on animal welfare issues. Such notions are value-laden, and partly for this reason they do not have a well-defined descriptive meaning outside the narrow scientific context. Even within the scientific community, different understandings of the concepts may be found. Obviously, in these circumstances, if these notions are used without being specified, there is a real danger that the associated advice will not be correctly understood.

Organic egg-production seems to be a case in which the definition of 'animal welfare' matters a great deal. Most scientists would probably agree that mortality rates, and the incidence of disease, are on average higher in organic egg-production than in conventional production systems (e.g. Permin et al., 1999). But whether the organic system is better or worse for the birds than a loose-housed system in which hens are kept permanently indoors depends to a large extent on the way in which animal welfare is defined. If the definition focuses on the idea that the animal should live according to its nature, then the large parasitic load and increase in mortality do not constitute problems. They can be seen as part of a natural life. If, on the other hand, the focus of the definition is on animal health, then obviously there is a problem.

It can be seen, then, that when a scientist is asked to evaluate the merits of e.g. a production system, it is vital that he or she clearly states the criteria of welfare being used — and, if possible, says what the consequences of applying other criteria would be.

Consider now discussion about whether mink should be housed with access to swimming water. In this discussion, notions such as 'frustration' and 'biological need' play a crucial role. At a first glance, the following two statements about the importance of swimming water for mink seem to contradict each other: "These results suggest that caging mink on fur farms does cause the animals frustration, mainly because they are prevented from swimming" (Mason et al, 2001); and "The results suggest that swimming is not a behavioural need in farm mink" (Hansen & Jeppesen, 2001). Is this, however, a scientific or conceptual disagreement? Hansen & Jeppesen compare mink with access to swimming water with mink in similar conditions apart from not having or ever having had swimming water available. They found no effects on the level of stereotypies of having access to swimming water. Their working assumption is that "the denial of fulfilment of behavioural needs could lead to the expression of stereotypies". Given this, mink without access to swimming water would be expected to show signs of frustration such as stereotypies. However, they offer an alternative explanation of their results: "it may be that, unlike some known needs, frustration caused by denied access to swimming does not express itself by stereotyped behaviour", i.e. the animals could be frustrated but not show this in stereotypic behaviour. As a consequence, they conclude that "whether swimming is a behavioural need in farm mink is still debatable". Mason et al. assess frustration in terms of the preference of mink for swimming water and the stress when access is

denied. They show that mink will work hard to maintain access to the water, and that mink which have had access to swimming water show an increase in cortisol production "indistinguishable from that caused by food deprivation" when access to the water is denied.

Apparently, then, what seems to be a scientific disagreement about whether or not mink should have access to swimming water to ensure their welfare, is not based on contradictions in scientific findings. One group measures the stereotypic behaviour of mink which have never had access to swimming water and the other the behavioural demand and cortisol response of mink which after having had access to swimming water are denied access. And it seems that the two sets of findings are compatible. A possible explanation of the difference in conclusions, as the authors suggest, is that not providing access to swimming does not lead to stereotypies in mink (Hansen & Jeppesen, 2001). However, an alternative explanation would be based on something other than scientific findings: the two groups may just be operating with different understandings of what it takes for an animal to be frustrated. Hansen and Jeppesen's starting point seems to be that frustration is related to the lack of fulfilment of a biological need, and that this in turn leads to an increase in stereotypies. Mason et al. on the other hand appear to operate with a different notion of frustration, which they cast in terms of animal preferences and physiology. However, what the authors in fact mean by "frustration" will remain speculation on our part. And that is exactly the problem. There seems to be a conceptual disagreement, but because key concepts such as 'frustration' are not well explained, readers (who will doubtless include people involved in making recommendations about fur farming) are really left without crucial information about the premises underlying the conclusions of the scientists.

Lack of scientific evidence

Scientists giving advice about an animal welfare issue will often find themselves in a situation in which they have fewer scientific data than they would like. Sometimes not all parameters relevant to the welfare assessment will have been measured. Sometimes only studies conducted within an artificial experimental setting will be available and it will be difficult to know to what extent the results are relevant to the issue as it occurs in real life. What should the scientist do in these situations?

The appropriate response will, of course, depend on the circumstances. In our view, however, it is in general a mistake to attempt to draw conclusions without reflecting on the lack of scientific evidence. An instructive case, in this regard, is a report by the Scientific Committee on Animal Health and Animal Welfare on force-feeding in geese and ducks (SCAHAW 1998).

Force-feeding in ducks and geese mainly occurs in France. The animals are force-fed for 12-15 (ducks) or 15-18 (geese) days, and then slaughtered. The aim is to produce a fatty liver, a foie gras. The force-feeding is carried out using an auger or a pneumatic device. The farmer catches the bird, inserts the pipe 20-30 cm into its throat and then starts the food-pumping procedure. If an auger is used, the time taken to deliver the food is 45-60 seconds; with a pneumatic device only 2-3 seconds are needed.

The conclusion of the committee was that "The evidence however suggests that it is very important for the further development of foie gras production to introduce alternative techniques that do not require force feeding" (Recommendation g, page 67). The committee acknowledged that this conclusion was based on a small number of studies and personal observations. But in fact when we look at the evidence presented in the report itself, we find little there to justify such a conclusion: "...blood corticosterone... This measure, therefore gives no evidence that intensive force feeding is stressful to the male hybrid duck" (p 41); "None of the measures used by Faure and his colleagues (1995-1998) indicate welfare problems. This conclusion could be due to the fact that the adrenal responses were of a small magnitude and that the sample sizes used were not large enough to reach statistical significance but in most of the cases not even tendencies were observed" (p 41).

(Two more recent papers on the welfare of force-fed birds should be mentioned in passing here: Guémené et al. 2001 and Faure et al. 2001. Guémené et al. looked at physiological indicators and found no indications of neither short-term nor long-term stress. Faure et al. used behaviour to measure aversion to the force-feeding situation itself, but found only a weak indication of aversion in ducks and none in geese.)

We can only speculate as to why the committee reached the conclusion it did. Was it on the basis of personal experience? Did the members perhaps have access to unpublished material? Did they rely on a definition of animal welfare which emphasises natural living? It is a problem that no answer to these questions is given in the report.

To ensure the credibility of science it is extremely important that, when they give advice on the basis of inadequate evidence, scientists clearly indicate the extent to which scientific evidence is lacking and explain how the conclusion has been reached in spite of this.

Uncertainty about priorities

The fourth and final kind of scientific uncertainty specifically concerns situations in which the scientist is asked for 'realistic' or feasible advice. When asking 'What is the welfare-optimal group size for egg-layers?' one is unlikely to want the answer, 'Twelve, with one rooster', even if that is true according to the scientific evidence. More probably the question meant is, 'Taking into consideration the costs associated with egg-production, and the fact that the producer has to have a margin of profit, and our climate, and our previous investments, what is the welfare-optimal group size for egg layers?' Obviously, the broader, implicit question requires the scientist to consider more than the science, something which can and has to be done.

A similar situation arises when researchers are asked to give a cut-off point — e.g. to state the maximum number of kg broiler/m^2. Here the scientist is being asked to make the decision despite insufficient data concerning the welfare of the animal, as well as being asked to come up with a 'realistic' bid which in essence means taking other considerations such as the farmer's economic survival into account. In the case of broilers, the only natural cut-off point would be where the

diminishing density does not make any difference to the welfare problems associated with broiler production. In many cases, however, scientists choose a less restrictive criterion (e.g. the 30 kg/m^2 criterion used for broilers, SANCO.B.3 2000), possibly because they realise that the scientifically defensible one will be viewed as unrealistic.

In the example just given, the scientists base their advice on something more than the scientific material present. To be sure, in many cases this cannot be avoided, but in these circumstances it is vital for the scientist to acknowledge the basis of the advice given and to state clearly in what way it is supported by the evidence and in what way it is based on other considerations.

Conclusion

Science makes an important input to discussions of animal welfare. When the acceptability or the regulation of some form of animal use is being discussed, the findings of scientists in applied ethology, neurophysiology, veterinary epidemiology and other disciplines will often be brought into the discussion. In many cases these findings will originally have been presented in scientific papers with a rather narrow focus, and often it is not the aim of the scientists in question to be involved in broader discussions about acceptable levels of animal welfare or animal welfare regulation. We readily acknowledge this situation and do not wish to claim that scientists should be held responsible for the ways in which their findings, as published in specialist scientific journals, are interpreted and used in broader contexts.

Our chief concern is instead with the role of scientists who are more or less directly involved in giving advice about animal welfare issues. Hence most of the sources referred to in the paper are reports from committees directly involved in giving scientific advice, and where we have included scientific papers, these are nearly all by authors who comment on broader or more practical issues. (Authors of the latter kind ought to be aware that they are not just presenting research results for those who work within their own fields because their statements pertaining to animal welfare can be viewed and used in an advisory capacity.)

The main message of the paper is that scientists, when they are involved in giving advice about animal welfare issues, have a responsibility to reflect on, and be open about, the limitations of the contribution that they can make *as scientists*. We do not for a moment wish to suggest that they should not also be engaged citizens who more or less passionately get involved in debates about animal welfare issues. However, when scientists are speaking as a *representative* of the scientific community, or making use of scientific material in giving advice, great care is called for. Aspects other than purely scientific ones may be involved in conclusions apparently based on pure science, and by emphasising existing differences in definitions and methodologies the scientist can clarify what the discussion is about, and what the alternatives are.

In this paper we have pointed to four ways in which things other than scientific findings may affect advice on animal welfare. One of these — lack of scientific evidence — is probably more familiar to scientists than the others. It is clearly a part of normal scientific training to assess the strength of

the evidence presented in favour of a claim, so here it is probably more a matter of making the uncertainty clear to a readership lacking first-hand knowledge of the relevant branch of science.

As we have sought to show, the interpretation of scientific results can also depend on ontological assumptions, and on assumptions about value. Picking up on the second of these points, it is of course true that a scientist can choose to use terms that are value-laden in an everyday conversation in a technical, value-free sense. However, if a term is to be successfully deployed in this technical way in general discussion involving non-specialists (or perhaps specialists in other fields), it is vital for the scientist to bear in mind that his or her interlocutors may be using the term with a different meaning. As a result of this, it may become necessary to address the unspoken, contrasting assumptions about value in a more direct manner.

The last way in which assumptions of a non-scientific kind can affect the advice on animal welfare given by scientists concerned priorities, often in the form of assumptions about the parameters of 'realistic' changes in animal housing, care or use. For scientists who are part of a research environment with a close link to a certain kind of animal use (e.g. in animal production or biomedical research), such assumptions will often be looked upon as expressions of common sense and taken for granted without any form of questioning. However, what one group of people take to be common sense may be taken by another group to involve a highly controversial ethical stance — for example certain kinds of animal use in food production and research have been questioned by various groups.

Finally, our message could be read as the claim that the role of science in discussions of animal welfare is less objective than many people would like to think. However, we would like to turn this claim around. By clarifying, and being ready to discuss, the assumptions behind their advice, scientists *fortify* their claim to be offering something that can be objectively assessed. To believe otherwise is to adopt a narrow-minded view according to which only scientific propositions can be objective. And once this view is rejected, it becomes possible to see that scientific advice on animal welfare will only seem to incorporate a subjective element if, and while, the scientist refuses to acknowledge that the advice he or she is offering may involve non-scientific assumptions. Whether those receiving the advice should accept it will, of course, depend on whether or not they accept the assumptions – scientific and non-scientific – on which the advice is based.

We would like to encourage those who produce and make use of science in an advisory context to consider the assumptions made and to identify other issues involved. In our opinion separating scientific data from assumptions made will facilitate the use of scientific results in an advisory context. Thus our claim is that by making clear the limits of science the true contribution of science to animal welfare will be more visible.

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